

REMARKS

This application has been amended. In particular, claim 3 has been amended to specify that the pre-treatment swelling step is carried out prior to applying any electroless plating to the polymer electrolyte. Support for this amendment can be found throughout the specification as filed, such as on page 19 and in Example 1 (on page 43). The phrase “the swelling step is a step for making” has also been reinserted into the seventh paragraph of claim 3, support for which can be found in previous versions of claim 3, and the word “capacitance” has been replaced by “capacity” to make the claim language consistent with the terminology used in the specification. Thus, no new matter has been added. Claims 3-6, 13-14, 17 and 21 are pending, of which claim 3 is in independent form. For the following reasons, Applicants submit that the pending claims are patentable over the cited art of record and the application is in condition for allowance.

Rejections Under 35 U.S.C. §112

Claims 3-6, 13, 14, 17 and 21 stand rejected under 35 U.S.C. §112, second paragraph for indefiniteness. In view of the foregoing amendments to claim 3, this rejection should be reconsidered and withdrawn.

The Office Action asserts that the phrase “prior to applying plating” in line 7 of claim 3 is indefinite because it is not clear whether the reference to “plating” is intended to mean “electroless plating.” Applicants have amended line 7 of claim 3 to insert the word “electroless” before “plating” to address this issue.

The Office Action further asserts that lines 12-13 of claim 3 are indefinite because the claim fails to connect the “pre-treatment step” with the swelling of the polymer electrode. Applicants have adopted the language suggested by the Examiner to address this issue.

Therefore, Applicants submit that the rejection of claims 3-6, 13, 14, 17 and 21 under 35 U.S.C. §112, second paragraph should be reconsidered and withdrawn.

Rejections Under 35 U.S.C. §103(a)

Claims 3-5, 13, 17 and 21 stand rejected under 35 U.S.C. §103(a) for obviousness over U.S. Patent No. 4,959,132 to Fedkiw in view of the admitted state of the art and U.S. Patent No. 6,426,863 to Munshi and claims 6 and 14 stand rejected under 35 U.S.C. §103(a) for obviousness over Fedkiw, the admitted state of the art, Munshi and U.S. Patent No. 5,024,858 to Burch. In view of the foregoing amendments to claim 3, this rejection is respectfully traversed.

Claim 3 is directed to a method for manufacturing an actuator element formed of a laminate comprising a metal layer and a polymer electrolyte. The method includes applying electroless plating to a polymer electrolyte, and the method contains both a pre-treatment step of swelling the electrolyte and, after the pre-treatment step, an electroless plating step comprising an adsorption step and a reduction step. Claim 3 has been amended to clarify that the pre-treatment swelling step occurs before any electroless plating is applied to the polymer electrolyte.

Through the pre-treatment swelling step, the polymer electrolyte is reformed, thereby reducing the crystallinity of the polymer electrolyte, alleviating entanglement of the side chains and increasing the degree of freedom of segmental movement of the side chains. By increasing the degree of freedom of the segmental movement through the pre-treatment swelling, the metal complex added in the subsequent adsorption step can be adsorbed deeper into the polymer electrolyte. The resulting laminate produced by this method has an electric double-layer capacity of 3 mF/cm^2 or more when a thickness of the laminate is converted to $170 \text{ }\mu\text{m}$.

On the other hand, Fedkiw is directed to a two-step process where the first step is an impregnation process in which a solid polymer electrolyte membrane is impregnated with an ionic salt or salts of the desired metal such as through the saturation of the membrane with a cationic metal salt solution and the second step is a reduction step in which an electrocatalytic film is formed on one face of the membrane. Fedkiw, thus, does not teach a pre-treatment swelling step. This difference between Fedkiw and the claimed invention appears to be acknowledged in the Office Action on pages 5 and 6.

However, the Office Action contends that, in view of the discussion in the background section of the subject application, it would have been obvious to modify Fedkiw to perform multiple adsorption/reduction cycles where the first of the adsorption/reduction cycles can be considered a “pre-treatment step” while subsequent adsorption/reduction cycles can be considered the adsorption and reduction steps. In coming to this conclusion, the Office Action states that “while the claim language provides that the pretreatment step is carried out before plating, it is not required to be carried out before ‘any’ plating, as long as a plating step occurs after the pretreatment step.” (Dec. 16, 2010 Office Action, page 6.)

Applicants have now amended claim 3 to clarify that, in the claimed method, the pre-treatment swelling step occurs before any plating of the electrolyte. Accordingly, even assuming one skilled in the art would consider it obvious to modify Fedkiw to undergo multiple adsorption/reduction cycles, the first of said cycles would not qualify as a pre-treatment swelling step as that step is defined in claim 3 because the first said cycle would not be performed before any plating is accomplished. Instead, performance of the first of multiple adsorption/reduction cycles would result in plating being applied to the electrolyte.

Munshi is cited as allegedly suggesting that it would be obvious to swell the polymer in order to increase the surface area and double layer capacity of the electrolyte. However, Munshi states that an object of the invention is to “provide a base polymer material that exhibits little or no swelling characteristics when in contact with liquid solvents.” (Munshi, col. 4, lines 3-6.) Munshi also mentions that the film of the invention should be capable of electrolyte retention “without appreciate swelling.” (Munshi, col. 6, lines 3-6.) In other words, Munshi specifically teaches away from modifying a base polymer material so that appreciable swelling occurs. Munshi is further distinguishable because the intended use of the polymer in Munshi is not for an actuator as in the present invention. Munshi also appears to be directed to a metal layer that is “attached” to a layer of the polymer material. Accordingly, Munshi does not cure the deficiencies discussed above in Fedkiw and the background art and, in fact, further teaches away from a pre-treatment swelling step in the process of manufacturing an actuator element.

Therefore, the rejection of claims 3-5, 13, 17 and 21 for obviousness over Fedkiw in view of the admitted state of the art and Munshi as well as the rejection of claims 6 and 14 for obviousness over Fedkiw, the admitted state of the art, Munshi and Burch should be reconsidered and withdrawn.

Claims 3-6, 13, 14, 17 and 21 stand rejected under 35 U.S.C. §103(a) for obviousness over the admitted state of the art in view of U.S. Patent No. 5,731,104 to Ventura, U.S. Patent No. 4,820,553 to Sopchak et al., and Munshi. This rejection is respectfully traversed.

The background section of the specification does not discuss a pre-treatment swelling step using a solvent which can achieve swelling of 30% or more. The Office Action asserts that Sopchak suggests exposing a resin to an organic solvent and then plating the resin. While Sopchak does not teach swelling of 30% or more, or any specific amount for that matter, the Office Action contends that one skilled in the art would glean from Sopchak's limited discussion that swelling of 30% or more would be optimal prior to an electroless plating process. The Office Action further cites Munshi as suggesting that swelling is desirable in order to increase the double layer capacity.

Applicants respectfully disagree that Sopchak provides the teachings concerning swelling of a polymer electrolyte which it is alleged to provide. Sopchak is directed to a process for conditioning the surface for polyesters and polyamides for electroless plating. The conditioning in Sopchak appears to primarily concern etching the skin layer on the surface of the polyester or polyamide, not swelling the polyester. (*See* Sopchak, col. 2, line 55: "One unique advantage of the etch process of this invention...") While Sopchak mentions swelling, Sopchak does not teach or suggest swelling the polyester or polyamide so that its thickness is 130% that of the thickness in the dry state. Sopchak's reference to swelling is much more limited. The amount of swelling is a significant advantage of the present invention and achieving this degree of swelling does not inherently result in any process in which a polymer is immersed in a solution. For example, the use of water as the swelling solution was found to achieve only a 5% swelling amount in the Comparative Examples of the subject application. Sopchak fails to provide any suggestion as to an amount of swelling that is desirable or how to achieve that particular level of swelling. Assuming one skilled in the art would understand from Sopchak,

which is primarily based on etching the surface, to swell the polyester to 130% of the thickness is improper and not supported by the actual teachings of Sopchak.

Moreover, reliance on Munshi as providing motivation to swell a polymer electrolyte so that its thickness is 130% that of the thickness in the dry state is misplaced. As discussed above, Munshi teaches away from swelling to any significant degree, instead suggesting that appreciable swelling should be avoided.

Ventura appears to be cited as suggesting that solid polymer electrolytes can be made from polyesters or other resins. Ventura does not appear to be directed to electroless plating or pre-treating polymer electrolytes by swelling the polymer electrolyte. Thus, Ventura does not cure the above deficiencies of the other references.

Therefore, the rejection of claims 3-6, 13, 14, 17 and 21 under 35 U.S.C. §103(a) for obviousness over admitted state of the art in view of Ventura, Sopchak and Munshi should be reconsidered and withdrawn.

Claims 3-6, 13, 14, 17 and 21 also stand rejected under 35 U.S.C. §103(a) for obviousness based on the admitted state of the art in view of Ventura, U.S. Patent No. 3,650,803 to Lin, and Munshi. These rejections are respectfully traversed.

Lin is directed to a process which includes forming a metal-phosphorus coating at the surface of a substrate to render the surface susceptible to conventional electroless plating. (Lin, column 1, lines 33-36.) Lin, like Sopchak, is concerned with reformulating the surface of the polymer substrate. The phosphorus surface coating is usually applied in a solvent, including solvents that are said to “swell a plastic surface or penetrate below the surface.” (Lin, column 4, lines 39-43.) However, as with Sopchak, Lin does not speak to an appropriate swelling amount, much less a swelling amount of 30% or more compared to the dry state of the polymer. As explained above, the degree of swelling is a key aspect of the invention. Water was known to achieve swelling, though Applicants have discovered that a more significant degree of swelling is appropriate, and this has led to the development of the claimed method. Lin does not suggest achieving the at least 30% degree of swelling defined in Applicants’ claims. Reading Lin as suggesting such a high degree of swelling, despite its limited discussion on the subject, appears to be an improper attempt to reconstruct the claims through hindsight reasoning.

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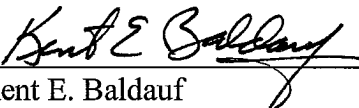
Moreover, reliance on Munshi as providing motivation to swell a polymer to 30% or more as compared to its dry state is misplaced. Munshi specifically speaks to limiting any appreciable swelling in a film, and therefore teaches away from the degree of swelling defined in the claims.

Therefore, the rejection under 35 U.S.C. §103(a) for obviousness over the admitted state of the art in view of Ventura, Lin and Munshi should be reconsidered and withdrawn.

CONCLUSION

For the foregoing reasons, Applicants submit that the pending claims are patentable over the cited art of record and are in condition for allowance. Accordingly, reconsideration of the outstanding rejections and allowance of pending claims 3-6, 13-14, 17 and 21 are respectfully requested.

Respectfully submitted,
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